2437
DC NULL DETECTOR

LEEDS & NORTHRUP

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SPECIFICATIONS

SENSITIVITY

Source Resistance (Ohms)	Microvolt/Division
Less than 5,000	Better than 0.5
Less than 50,000.	Better than 1.0.

SENSITIVITY CONTROL
Continuously adjustable; provides 100:1 attenuation ratio.

NOISE
Less than 0.5 microvolt peak-to-peak for source resistance of 50,000 ohms.

ZERO DRIFT
Less than 1.0 microvolt per hour after 1/2 hour warm-up.

ZERO ADJUST RANGE
0 to ±20 microvolts.

ZERO SHIFT WITH SOURCE RESISTANCE CHANGE (CURRENT OFFSET)
0.5 microvolt for a change of 10,000 ohms.

LINE FREQUENCY REJECTION (50 OR 60 Hz)
Common Mode: greater than 140 dB.
Differential Mode: greater than 90 dB.

STEP RESPONSE TIME (CENTER TO 90% OF FULL SCALE)

Source Resistance (Ohms)	Time (Seconds)
0 to 1000	1.2
10,000	4.1
50,000	5.2

INPUT IMPEDANCE
Greater than 50,000 ohms.

INPUT OVERLOAD VOLTAGE (DC OR RMS AC)
20 volts maximum.

ISOLATION
Greater than 10^9 ohms from input to ground.

METER
−25 to 0 to +25 microamperes dc; taut-band suspension; 1.3-inch scale with 20 divisions marked 10, 5, 0, 5, 10; each division equal to 1.7 mm.

POWER SUPPLY REQUIREMENT
12-13 volts dc, 3.5 milliamperes.

2437
DC NULL DETECTOR

1. INTRODUCTION

The 2437 DC Null Detector is a solid-state voltage sensing device designed for use as a null detector in most applications using modern precision potentiometers or bridges requiring sensitivities to one microvolt.

This detector has many advantages over most voltage sensors such as light beam galvanometers in that it has better sensitivity, higher impedance, faster response, and is not damaged by large ac or dc overloads. Since it is not appreciably affected by vibration and does not have to be level, it may be operated in any position at any location reasonably free from severe vibrations. Moreover, since this detector may be operated by batteries, coupling to ac power lines, which often causes trouble in conventional electronic null detectors, can be greatly reduced. Furthermore, its input filter reduces the adverse affects of ac components in the dc input signal.

Table I lists and describes the various models of the 2437 DC Null Detector presently available and their corresponding power supplies. Fig. 1 illustrates a 2437-0-00 DC Null Detector.

E5422

Fig. 1–2437-0-00 DC Null Detector.

TABLE I–2437 DC NULL DETECTORS AND CORRESPONDING POWER SUPPLIES

DETECTOR		POWER SUPPLY		
CATALOG NO.	MODEL	TYPE	DESCRIPTION	PART NO.
2437-0-00	Bench	- - - - -	- - - - - - - - - - - - -	- - - -
2437-0-10	"	Battery	Two 6-volt batteries	(2) 056053
2437-0-20	"	Battery	Battery holder and two mercury batteries	099098
2437-0-30	"	Power Supply	120-volt, 50-60 Hz, rechargeable battery	099099
2437-0-31	"	Power Supply	230-volt, 50-60 Hz, rechargeable battery	099123*
2437-0-40	"	Power Supply	120-volt, 50-60 Hz	099083
2437-0-41	"	Power Supply	230-volt, 50-60 Hz	099120*
2437-1-00	Panel	- - - - -	- - - - - - - - - - - - -	- - - -
2437-1-10	"	Battery	Two 6-volt batteries	(2) 056053
2437-1-40	"	Power Supply	120-volt, 50-60 Hz	099084
2437-1-41	"	Power Supply	230-volt, 50-60 Hz	099121*
2437-2-00	Component	- - - - -	- - - - - - - - - - - - -	- - - -
2437-2-10	"	Battery**	Two 6-volt batteries	(2) 056053
2437-2-40	"	Power Supply**	120-volt, 50-60 Hz	099055
2437-2-41	"	Power Supply**	230-volt, 50-60 Hz	099122*

*Supplied without plug on line cord.
**Designed for mounting in portable instruments.

2. ACCESSORY EQUIPMENT

2A. Battery and Power Supplies

The 2437 DC Null Detector may be energized by the batteries or power supplies indicated in Table I. Instructions for mounting these components on the detector are furnished with the individual supplies.

2B. Relay-Rack Mounting Frame

A panel model of this detector together with two other similar items of equipment—such as 6-inch wide, modular-type L&N instruments or 6-inch wide blank plates—may be mounted on a standard 19-inch relay rack or L&N facility by means of the relay-rack mounting frame provided in Parts Kit 124592. Directions 177412, provided with this kit, outline the instructions for mounting the frame on a standard 19-inch relay rack or L&N facility and the detector and other appropriate equipment on the frame.

3. INSTALLATION

3A. Unpacking

Remove the detector from its packing case and then remove any shipping ties, clamps, or packing material. Follow the instructions on any tags attached to the detector and then remove the tags.

3B. Mounting Instructions

(1) Bench Model

Locate the detector and any accessory equipment on a bench or level surface.

(2) Panel Model

Install the detector in the user's facility (standard 19-inch relay rack or L&N facility) by means of a relay-rack mounting frame (Parts Kit 124592).

(3) Component Model

The component models of this detector—namely, 2437-2-00, -10, -40, or -41—were designed as replacements for the lamp and scale galvanometers of such portable L&N instruments as the 8686 Millivolt Potentiometer and the 8687 Volt Potentiometer. Instructions for replacing a lamp and scale galvanometer with a component model of this detector are outlined in Directions 177497, which are furnished with the component model.

4. OPERATION

4A. Controls, Meter, and Terminals

The diagram symbols and functional descriptions of the detector controls, meter, and terminals are listed in Table II.

4B. Initial Preparation

The dc power for this detector may be obtained from the batteries or power supplies indicated in Table I. It may also be obtained from any power supply having a dc output of 12 to 13 volts at 3.5 milliamperes with a ripple of less than 5 millivolts.

TABLE II–DETECTOR CONTROLS, METER, AND TERMINALS

CONTROL, METER OR TERMINALS	DIAGRAM SYMBOL	FUNCTIONAL DESCRIPTION
Sensitivity Control	R2	Continuously adjusts sensitivity over a wide range; the OFF position (counter-clockwise limit) turns off dc power.
Zero Control	R1	Permits adjustment of meter zero or cancellation of circuit emf's.
Meter	M1	Provides output indication proportional to input signal.
DETECTOR Terminals	1 and 2	Provided for connection of detector to measuring device being used.
12-13 V. D.C. Terminals	+ and –	Provided for connection of external battery or dc power supply.
Trimmer Capacitor	C4	Balances current offset in the input circuit.

Before connecting a power source to the detector, check that the meter pointer rests at zero. If it doesn't, adjust the pointer position with the meter-zero adjusting screw.

Set the SENSITIVITY control to OFF. Then connect the batteries or power supply to the 12-13 V. D.C. + and – terminals.

4C. Operating Procedure

To operate the null detector, proceed as follows:

1. Set the SENSITIVITY control to OFF (counterclockwise limit).

2. Connect DETECTOR 1 and 2 terminals to the proper points in the measuring system. Note that the DETECTOR 1 terminal is the common side of the detector input and the DETECTOR 2 terminal is the positive side.

> CAUTION: Make sure that the detector input signal does not exceed 100 volts with respect to ground. A signal in excess of this value may damage the detector.

3. Turn the SENSITIVITY control to its maximum sensitivity position (clockwise limit). Then adjust the ZERO control until the meter indicates zero.

> NOTE: When the detector is used with a rechargeable battery power supply and the supply is battery-operated (line cord disconnected from ac source), it may be necessary to rezero the detector periodically until the battery voltage stabilizes.

4. Turn the SENSITIVITY control to its minimum sensitivity position (not its OFF position).

5. Tap the "low" sensitivity key of the measuring device and note the direction of the meter pointer deflection.

6. While tapping the "low" sensitivity key, adjust the measuring device until the deflection decreases appreciably.

7. Repeat Step 6 while tapping the "medium" key, if provided. Then repeat Step 6 while tapping the "high" key.

8. Increase the detector sensitivity, tap the "high" sensitivity key, and adjust the measuring device until the meter pointer deflection is minimal.

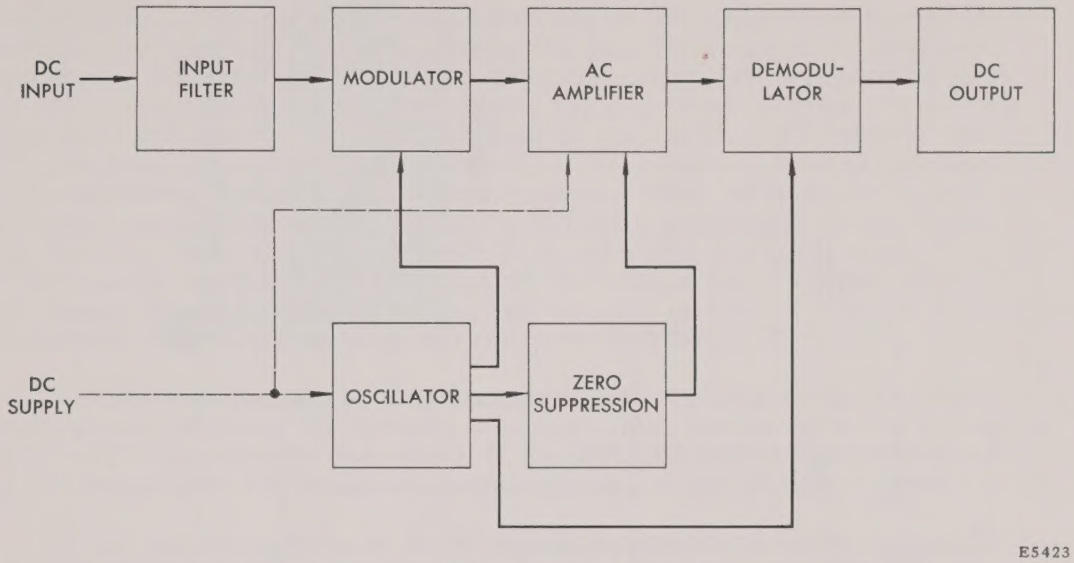


Fig. 2–Block diagram of 2437 DC Null Detector.

9. Repeat Step 8, increasing the sensitivity with each repetition, until the meter pointer does not deflect or until the deflection is minimal.

The measuring device will now indicate the value of the unknown.

5. CIRCUIT DESCRIPTION

As indicated in Figs. 2 and 3, the circuit of this detector consists of an input filter, a synchronous modulator, an ac amplifier, a synchronous demodulator, a meter output, a zero suppression circuit, and a multivibrator circuit.

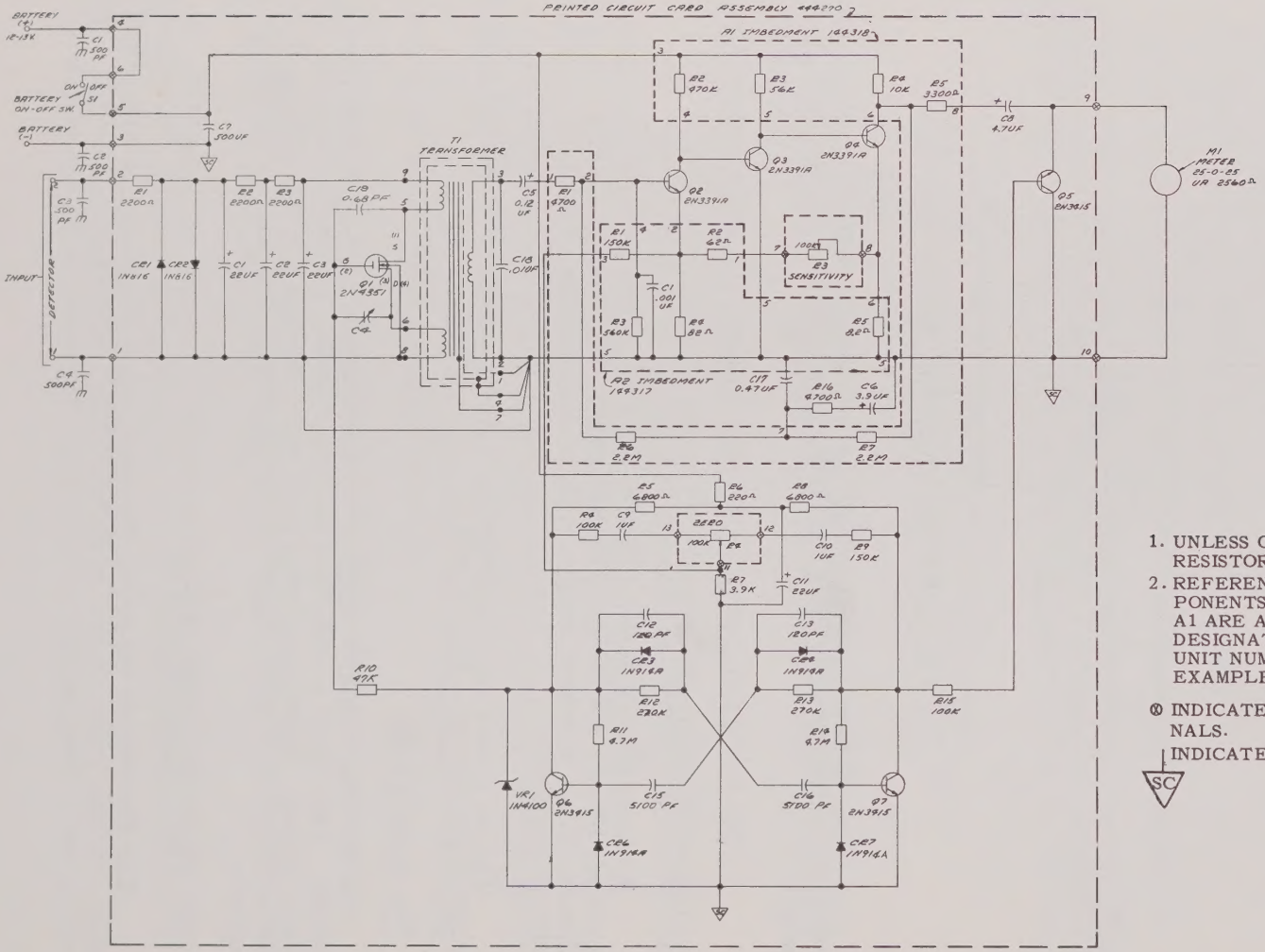
The dc power for this detector may be obtained from any external source described in Section 4B.

5A. Input Filter

A dc input signal is applied to the detector through a 3-stage RC filter. This filter minimizes the effect of any ac interference in the dc input signal. Limiting diodes CR1 and CR2 prevent the application of an excessively high input signal to the field effect transistor and filter capacitors.

5B. Synchronous Modulator

The filtered dc output of the input filter is converted into a 350-Hz signal by the synchronous modulator (field effect transistor Q1). This converter is essentially a single-pole single-throw switch which is



NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4 W 10%.
2. REFERENCE DESIGNATIONS FOR COMPONENTS OF PRINTED CIRCUIT CARD A1 ARE ABREVIATED. PREFIX THE DESIGNATIONS (A1, R1, C1, ETC.) WITH UNIT NUMBER (A1) WHEN DISCUSSING. EXAMPLE: A1R1, A1A1R1, A1A2R1 ETC.

⊗ INDICATES P.C. CARD 444270 TERMINALS.

INDICATES SIGNAL COMMON.

SC

J-D-2219-30E

Fig. 3–Schematic diagram of 2437 DC Null Detector.

operated by a 350-Hz (approximately) signal obtained from the multivibrator circuit and applied between the gate (G) lead of Q1 and signal common. When this signal has a positive value, Q1 is turned on—that is, the resistance between the source (S) and drain (D) leads becomes less than 250 ohms. When this signal is zero or has a negative value, Q1 is turned off—that is, the resistance between the source and drain leads becomes greater than 100 megohms. Thus when Q1 is turned on, the input signal can flow through the primary windings of input transformer T1. Conversely, when Q1 is turned off, the input signal cannot flow through the primary windings of T1. Since Q1 is driven by an output signal from the multivibrator, the on-off operation of Q1 is in synchronism with the frequency of the multivibrator.

The on-off flow of the dc input signal through the primary windings of input transformer T1 induces a square wave in the secondary winding of T1. The magnitude and phase of the induced voltage is proportional to the magnitude and polarity, respectively, of the dc input signal.

If the polarity of the dc input signal reverses, then the signal flows through the primary windings of T1 in the opposite direction. Consequently, the induced voltage is 180 degrees out of phase with the induced voltage that would result from a dc input signal having the original polarity.

5C. AC Amplifier

Alternating current amplification of the square wave signal is provided by a 3-stage, direct-coupled, NPN-transistor amplifier consisting of transistors Q2, Q3, and Q4 and associated capacitors and resistors. This amplifier utilizes the common-emitter configuration for high power amplification. The negative feedback circuit of the amplifier, which includes sensitivity control R3, limits the gain of the amplifier. Maximum gain is achieved by opening the feedback path (clockwise limit of R3). The amplifier output is applied to demodulator transistor Q5 and the meter through resistor R5 and capacitor C8.

5D. Synchronous Demodulator and Meter Output

The synchronous demodulator (transistor Q5) converts the ac output of the amplifier into a pulsating dc signal that is measured by meter M1. The demodulator brings this about as follows.

Transistor Q5 is biased by the square-wave signal from the multivibrator circuit so that it is turned off during the first half-cycle of the multivibrator signal and turned on during the second half-cycle. When Q5 is turned on, its emitter-to-collector resistance is very high, permitting current to flow through the meter; when Q5 is turned off, its emitter-to-collector resistance is very low, permitting current to flow through the transistor instead of the meter. Thus a pulsating unidirectional dc signal is applied to the zero-center meter, causing its pointer to deflect in one direction. If the polarity of the detector input signal

changes, current will flow through the meter when Q5 is turned on. However, in this instance, the current flows through the meter in the opposite direction, causing its pointer to deflect in the opposite direction.

5E. Zero Suppression Circuit

The zero suppression circuit consists of zero control R4, capacitors C9 and C10, resistors R7 and R9, and resistors R1 and R4 of imbedment A2. When zero control R4 is near the center of its travel, the output of the zero suppression circuit is zero. Settings on either side of the center provide outputs that are in- or out-of-phase with the input signal to the ac amplifier, consequently increasing or attenuating the ac amplifier output.

5F. Multivibrator Circuit

The multivibrator circuit (transistors Q6 and Q7 and associated components) is a free-running (astable) multivibrator. It is essentially a nonsinusoidal oscillator in which one stage is turned on (conducts) while the other stage is turned off (does not conduct). The turned off stage will remain turned off until an operating point is reached at which the two stages reverse their operating conditions—that is, the stage which has been conducting is turned off and the stage which has not been conducting is turned on.

The oscillating frequency of this multivibrator is about 350 Hz and is determined by two RC circuits: resistor R12 and capacitor C16, and resistor R13 and capacitor C15. Diodes CR6 and CR7 limit the negative spikes applied to the bases of transistors Q6 and Q7, respectively, while diodes CR3 and CR4 function as squaring diodes. Zener diode VR1 limits the magnitude of the square wave drive.

6. SERVICING

Should the detector fail to operate properly, locate the fault by following the troubleshooting procedure outlined in Section 6B.

If a measured voltage, current, or resistance differs from the check value by more than 20% (unless otherwise noted), analyze the circuit to determine which component is most likely at fault.

If the fault is traced to a particular component, replace the component or the printed circuit card on which it is mounted. Section 6C outlines the procedure for replacing defective printed-circuit-card components.

6A. Test Equipment

The following items of test equipment are needed to troubleshoot this detector:

Simpson Model 260 Volt-Ohm-Milliammeter (VOM) or equivalent.

RCA Volt Ohmyst (VTVM) or equivalent.

Calibrated Oscilloscope—1 mV sensitivity with 1 megohm probe.

6B. Troubleshooting Procedure

Troubleshoot the detector by making the measurements and tests outlined in the following subsections in the order indicated. Make all measurements between the specified test points and the circuit common. Refer to Figs. 3 and 4 for the locations of the test points.

(1) Preliminary Information

For proper operation of the detector, the voltage of the external dc power supply should be between 11 and 14 volts. When this voltage is 12.5 volts, the detector operating current should be 3.5 mA. This voltage should be 12.5 volts when making the tests and measurements outlined in the following subsections.

(2) Functional Test

With the detector input shorted and the sensitivity control at its maximum setting (clockwise limit), a 30-degree rotation of the zero control should result in a meter pointer deflection from one end of the scale to the other (10 to 10). Such a deflection indicates that the following circuits are functioning: ac amplifier, oscillator, demodulator, and zero suppression.

(3) DC Voltage

With a 12.5-volt dc power supply connected to the detector and the sensitivity control set near midpoint, make the dc voltage measurements indicated in the following table using the VTVM.

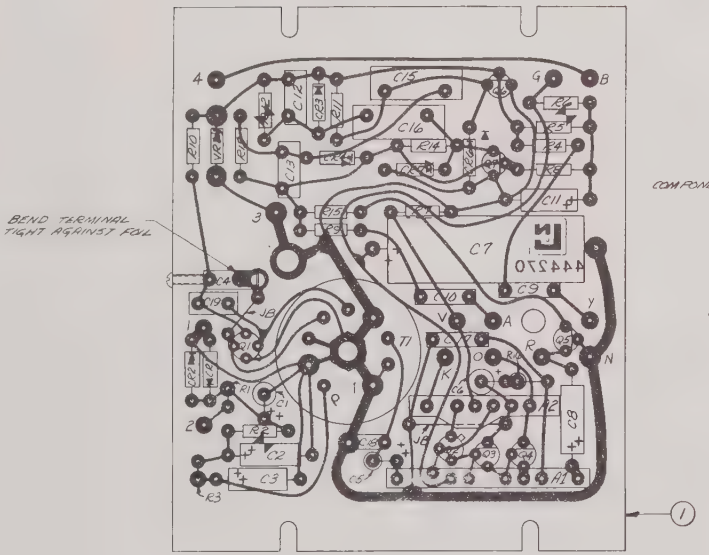
TEST POINT	DC VOLTAGE
Q2 Base	0.55 V
Q2 Collector	0.55 V
Q3 Collector	0.58 V
Q4 Collector	5.7 V*

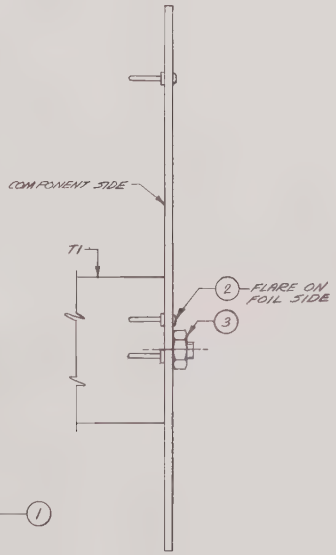
*Depends on the operating characteristics of transistor Q2—may be between 4 and 8 volts.

(4) Resistance

With the dc power supply disconnected from the detector and the detector turned off, make the resistance measurements indicated in the following table using the VTVM—R x 1000 range.

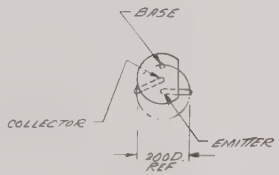
SYMBOL	DET	QTY	PART OR DWG. NO.	DESCRIPTION
	66			
	65			
	64			
	63			
	62			
JB	61	AR	#20-32.26	SOL CU TN WIRE
	60			
A2	59	1	144317	IMBEDMENT
A1	58	1	144318	IMBEDMENT
Q2	57	1	188188	TRANSISTOR (2N930)
Q5, Q6, Q7	56	3	188221	TRANSISTOR (2N1893)
Q3, Q4	55	2	188165	TRANSISTOR, SILICON (2N3711)
Q1	54	1	188249	TRANSISTOR MOSFET (2N4351)
	53			
VR1	52	1	057116	DIODE, ZENER 7.5V ± 5%
	51			
CR7	50	1	188056	DIODE, SILICON (1N914A)
CR6	49	1	188056	DIODE, SILICON (1N914A)
	48			
CR4	47	1	188056	DIODE, SILICON (1N914A)
CR3	46	1	188056	DIODE, SILICON (1N914A)
CR2	45	1	057044	STABISTOR (1N816 OR 3622)
CR1	44	1	057044	STABISTOR (1N816 OR 3622)
	43			
T1	42	1	019400	TRANSFORMER
	41			
C19	40	1	023683	CAPACITOR, 0.6 PF, 300 W.V.D.C.
C18	39	1	023451	0.01 µf, 50 W.V.D.C.
C17	38	1	023367	0.47 µf, 25 W.V.D.C.
C16	37	1	023398	5100 PF, 300 W.V.D.C.
C15	36	1	023388	5100 PF, 300 W.V.D.C.
	35			
C13	34	1	023360	120 PF, 300 W.V.D.C.
C12	33	1	023360	120 PF, 300 W.V.D.C.
C11	32	1	023303	22 µf, 15 W.V.D.C.
C10	31	1	023415	1 µf, 25 W.V.D.C.
C9	30	1	023415	1 µf, 25 W.V.D.C.
C8	29	1	023582	4.7 µf, 50 W.V.D.C.
C7	28	1	023529	300 µf, 15 W.V.D.C.
C6	27	1	023455	3.3 µf, 20 W.V.D.C.
C5	26	1	023669	0.12 µf, 35 W.V.D.C.
C4	25	1	023665	TRIMMER
C3	24	1	023303	22 µf, 15 W.V.D.C.
C2	23	1	023303	22 µf, 15 W.V.D.C.
C1	22	1	023303	CAPACITOR, 22 µf, 15 W.V.D.C.
	21			
R16	20	1	311112	RESISTOR, 4700 Ω, 1/4 W, 10%
R15	19	1	311370	" 100 K, "
R14	18	1	311376	" 4.7 MΩ, "
R13	17	1	311261	" 270 K, "
R12	16	1	311261	" 270 K, "
R11	15	1	311376	" 4.7 MΩ, "
R10	14	1	311111	" 47 K, "
R9	13	1	011769	" 150 K, "
R8	12	1	011770	" 6.8 K, "
R7	11	1	011936	" 3900 Ω, "
R6	10	1	311113	" 220 Ω, "
R5	9	1	011770	" 6.8 K, "
R4	8	1	311370	" 100 K, "
R3	7	1	011927	" 2200 Ω, "
R2	6	1	011927	" 2200 Ω, "
R1	5	1	011927	RESISTOR, 2200 Ω, 1/4 W, 10%
	4			
	3	1		#6-32 NUT, HEX BR. CR. P.
	2	13	360076	TERMINAL (MALE PIN)
	1	1	144321	PRINTED CIRCUIT CARD





NOTES

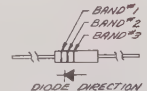
1. POSITION COMPONENTS FOR BEST READABILITY OF COMPONENT INFORMATION AT ASSEMBLY.
2. SOLDER PER ESS 3.1.10.5
3. MAX HEIGHT OF SOLDER JOINTS TO BE 1/32.
4. FLUX MUST BE CLEANED THOROUGHLY FROM BOTH SIDES OF CARD AFTER SOLDERING.



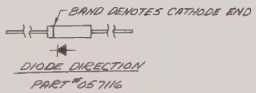
DETAIL 55
SCALE 4:1
TYP. LEAD BENDING

DETAIL 54, 57

DETAIL 55, 56



PART NO.	BAND COLOR 1	2	3
057044	RED	RED	---
188056	WHITE	BROWN	YELLOW



444270

Fig. 4–444270 Printed Circuit Card.

TEST POINT	RESISTANCE
Q2 Base	7 kΩ
Q2 Collector	6.4 kΩ
Q3 Collector	6.2 kΩ
Q6 Base	6.6 kΩ
Q7 Base	6.6 kΩ

(5) AC Voltages

(a) Transistors Q1 (FET) and Q7 (Multivibrator Circuit)

With a 12.5-volt dc power supply connected to the detector and the detector turned on, make the ac voltage measurements indicated in the following table using the oscilloscope. Note that the stated values are peak-to-peak values.

TEST POINT	AC VOLTAGE	WAVEFORM
Q1 Gate	7.2 V	Fig. 5 (2 V/cm—1 ms/cm)
Q7 Collector	11 V	- - -

(b) Amplifier Circuit

With a 12.5-volt dc power supply connected to the detector, and the detector turned on, make the ac voltage measurements indicated in the following table with the oscilloscope. Note that the stated ac voltage values are peak-to-peak and should result from the application of the indicated input signals.

TEST POINT	INPUT SIGNAL	AC VOLTAGE	WAVEFORM
Q2 Base	1 mV	2.7 mV*	Fig. 6 (1 mV/cm—1 ms/cm)
Q4 Collector	10 μV	2 V**	Fig. 7 (1 V/cm—1 ms/cm)
Meter +	10 μV	0.6 V**	Fig. 8 (1 V/cm—1 ms/cm)

*Sensitivity control at its minimum sensitivity position.
**Sensitivity control at its maximum sensitivity position.

(6) Zero Shift with Same Resistance Change (Current Offset)

Trimmer capacitor C4, Figs. 3 and 4, is an adjustable capacitor for controlling the current offset in the detector input circuit.

The following items will be required should adjustment of the current offset become necessary:

- 10,000-ohm wire-wound resistor.
- Single-pole single-throw switch with plated contacts—switch must be suitable for low level switching.
- Non-conducting adjusting tool or screwdriver.

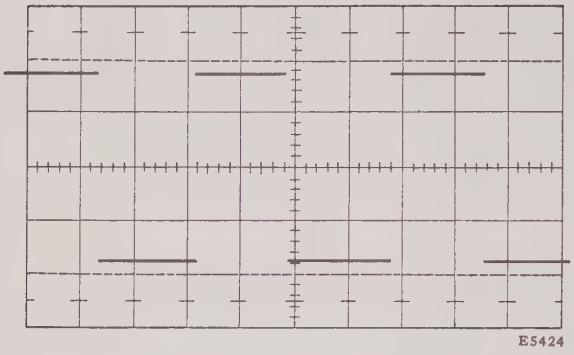


Fig. 5–MOS-FET modulator drive (Q1 gate).

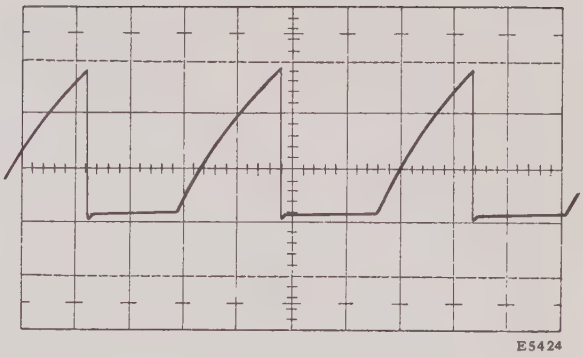


Fig. 6–Amplifier input (Q2 base).

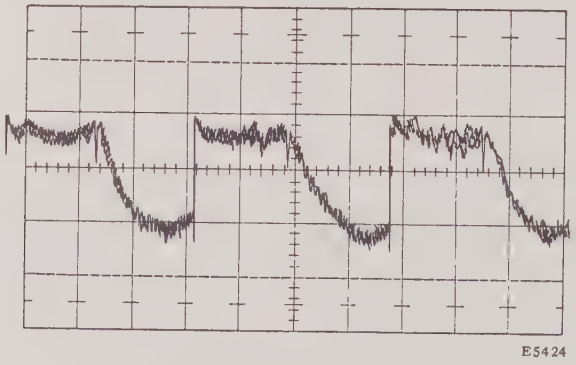


Fig. 7–Amplifier output (Q4 collector).

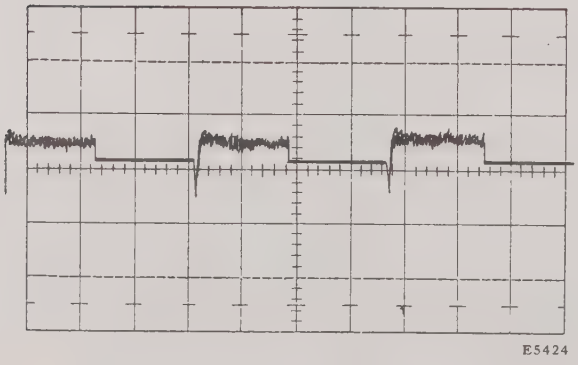


Fig. 8–Meter (meter +).

To make the adjustment, proceed as follows:

1. Connect the spst switch and the 10,000-ohm resistor to the detector as indicated in Fig. 9, observing the following four precautions while making the connections:

- Cover the connections to the switch and resistor to reduce thermal emfs.
- Twist the leads connected to DETECTOR terminals 1 and 2 to eliminate pickup.
- Use the dc power supply normally used with this detector.
- If the detector under test is a bench model detector, remove its outer case.

2. Close the spst switch and turn the sensitivity control to the maximum sensitivity position (Clockwise limit). Then adjust the zero control until the meter pointer indicates zero.

3. Open the spst switch and then allow the meter pointer to stabilize. If the pointer has shifted from zero by more than 0.5 microvolt, adjust trimmer capacitor C4 as directed in Step 4.

4. Insert the adjusting tool or screwdriver through the hole in the rear of the detector case and adjust trimmer capacitor C4 until the meter pointer shifts less than 0.5 microvolt from zero when the spst switch is opened or closed.

5. If the detector under test is a bench model detector, remount its outer case.

6C. Replacing Defective Printed-Circuit-Card Components

Remove the defective part from the card by cutting the leads of the part at the component side of the card. Unsolder the remaining (crimped) portions of the leads from the foil side of the card with a small-tip low-voltage (25-40 watt) soldering iron. Perform this unsoldering as quickly as possible to prevent the heat from loosening the copper foil. Make sure that the melted solder does not obstruct the mounting holes by removing the excess solder from the leads with a suction bulb and Teflon tube (Little Joe Solder Remover, SR-25, Mills Equipment Company, or equivalent). Insert the leads of the replacement part through the holes in the card, cut off the excess wire, bend the leads slightly on the foil side, and then solder the leads in place. The soldered joints should not project more than 1/16 of an inch above the card surface. When soldering diodes or transistors, hold the lead between the component body and the card with a heat sink, such as a pair of long-nose pliers.

CAUTION: FET transistor Q1 has an extremely high input resistance. It can, therefore, accumulate a high electro-static charge that will cause its own destruction, if its gate is permitted to float during removal or replacement. To prevent such destruction, observe the precautions outlined in Section 6D.

6D. Precautions When Removing or Replacing FET Transistor Q1

Before removing or replacing the FET transistor, ground yourself. Grounding may be effected by wearing a metal watch band to which is attached a copper braid or wire that is connected to ground.

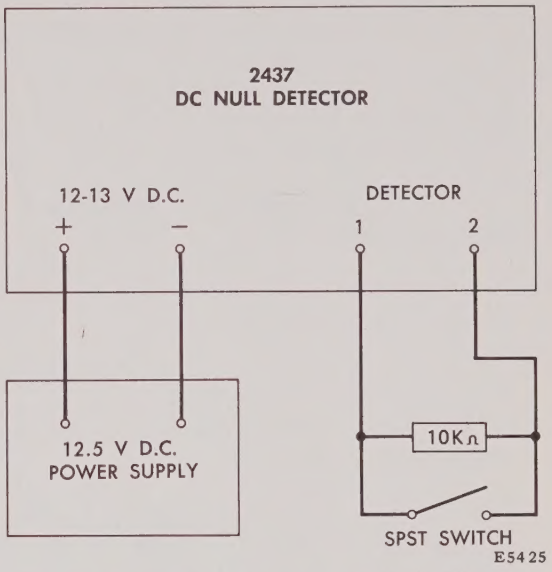


Fig. 9–Connections for current offset adjustment.

Use only a grounded soldering iron to unsolder the FET transistor and to solder its replacement.

Remove the replacement FET transistor from its foil-lined carton, remove the metal shorting grommet from the transistor leads, and mount the transistor on the printed circuit card as directed in Section 6C. (Do not remove the shorting grommet until the FET transistor is about to be mounted.)

7. REPLACEMENT PARTS

Table III lists replacement parts for the 2437 DC Null Detector.

TABLE III–REPLACEMENT PARTS

DESCRIPTION	L&N PART NO.
Printed Circuit Board Assembly	444270
Meter	021097
Zero Control	013373
Sensitivity Control	013374
Control Knob	002269
Bench Model Foot	041026
Batteries	
6-Volt Batteries (Suffix 10)	(2) 056053
Mercury Batteries (Suffix 20)	(2) 056052
Rechargeable Nickel-Cadmium Battery (Suffix 30 or 31)	056054

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